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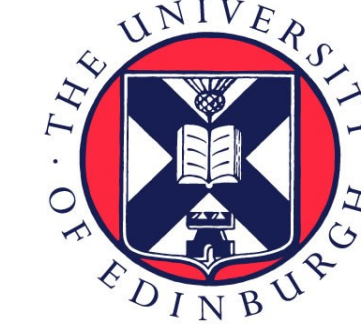
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Adaptation in Motor Imitation: Models Use Visual Feedback to Adapt to Imitators' Actions

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Background

Action execution is facilitated when it matches the observed movement (Heyes, 2011). In a joint task setting, the participant ('follower') initiates action quicker when she imitates her partner ('model'), as compared to when she counter-imitates. Interestingly, Pfister et al. (2013) found a similar facilitation on the side of the model, i.e. the model is faster when he knows he is about to be imitated. The authors argued that the model anticipates the follower's actions, and when they match his own, action selection is facilitated.

But alternatively, the model might dynamically adapt to the follower's response speed (cf. Konvalinka et al., 2010). If this is the case, the model will be faster when he is being imitated simply because the follower is faster in this condition.

We hypothesised that models use visual and auditory feedback about their partner's performance in order to dynamically adapt their own actions. Therefore, removing this feedback should considerably attenuate any facilitative effect of imitation in the model.

We ran two experiments:

In Experiment 1, we used the paradigm of Pfister et al. (2013) in an attempt to replicate their findings.

In Experiment 2, we investigated whether removing the visual and auditory feedback attenuates the facilitative effect in the model.

Method

Experiment 1

- 12 pairs (R-handed, same-gender)
- Participants are assigned roles of a 'leader' (model) and 'follower'
- They sit across a table
- Model observes cues on a computer screen
- Model executes a SHORT (<150ms) or LONG (200-600ms) button press
- Follower is instructed to either imitate or counter-imitate the type of the button-press
- Condition (counter- vs imitation) is blocked (within-participant)
- Both participants are informed about the condition at the beginning of each block
- Participants change roles half-way through the session

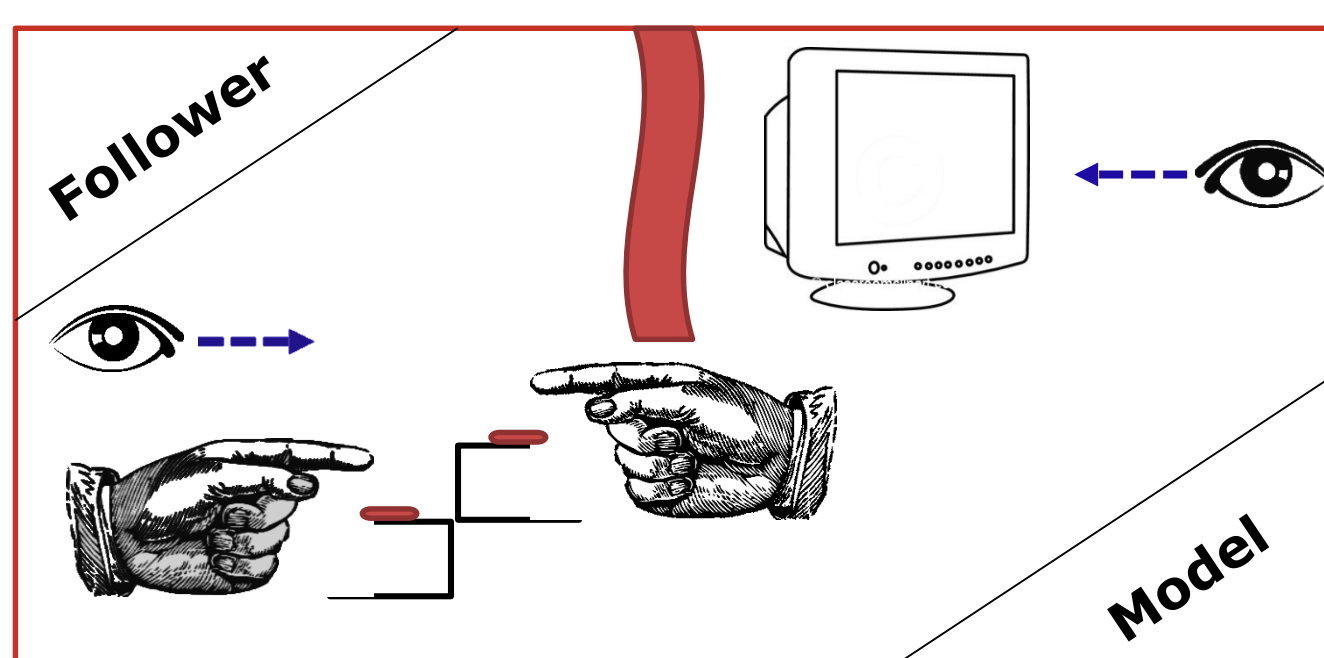


Figure 1 Experimental set-up in Exp2

Experiment 2

- 12 pairs (R-handed, same-gender)
- Model wears earplugs and noise-cancelling headphones (Sony MDR-NC60)
- A divider prevents the model from seeing the follower, but the follower can see the model's hand

Data trimming

We excluded NA's and outliers (± 2.5 SD). For the analysis of model data we excluded model errors; for follower's data both model and follower errors. Error rate was not affected by Condition. Overall, excluded 14% trials in Exp1/Exp2.

Results

Follower's RT

EXP1		MODEL press type	EXP2	
Counter-imitation	Imitation		Counter-imitation	Imitation
371 (6)	311 (4)	LONG	392 (6)	308 (4)
498 (6)	339 (4)	SHORT	526 (6)	328 (3)

Table 1 Follower's RT, means and SE reported in milliseconds. RT calculated from the last press/release performed by the model

We replicated the facilitative effect of imitation on Follower's action execution (Exp1, $t(23)=5.79$, $p<.001$; Exp2, $t(23)=6.71$, $p<.001$).

There was a signif. interaction Condition*Model Press Type, suggesting the facilitative effect was driven by SHORT presses in Counter-imitation (Exp1, $F(1,23)=14.41$, $p<.001$; Exp2, $F(1,22)=12.30$, $p<.01$).

Model's RT

EXP1		MODEL press type	EXP2	
Counter-imitation	Imitation		Counter-imitation	Imitation
445 (19)	427 (17)	LONG	443 (3)	444 (3)
429 (19)	405 (16)	SHORT	440 (4)	425 (3)

Table 2 Model's RT, means and SE reported in milliseconds

In Exp1, we replicated the facilitative effect in the Model ($t(23)=3.22$, $p<.01$).

Importantly, after removing feedback in Exp2 the effect of Condition was no longer significant ($t(23)=1.20$, $p=.24$).

The Condition*Model Press Type interaction was n.s. in Exp1 ($F(1,23)=1.36$, $p>.05$) and signif. in Exp2 ($F(1,23)=5.67$, $p<.05$; but Bonferroni t-tests n.s.). Main effect of MPT only in Exp1, $F(1,23)=7.62$, $p<.05$.

Results: Adaptation

RT's over time

In Exp1, we found a main effect of Trial Block, suggesting that both Model and the Follower gradually sped up as the task progressed (Model, $F(2.61,54.75)=4.73$, $p[GG]<.01$; Follower, $F(2.37,47.4)=3.39$, $p[GG]<.05$). **This effect was not present in Exp2.**

Model*Follower RT

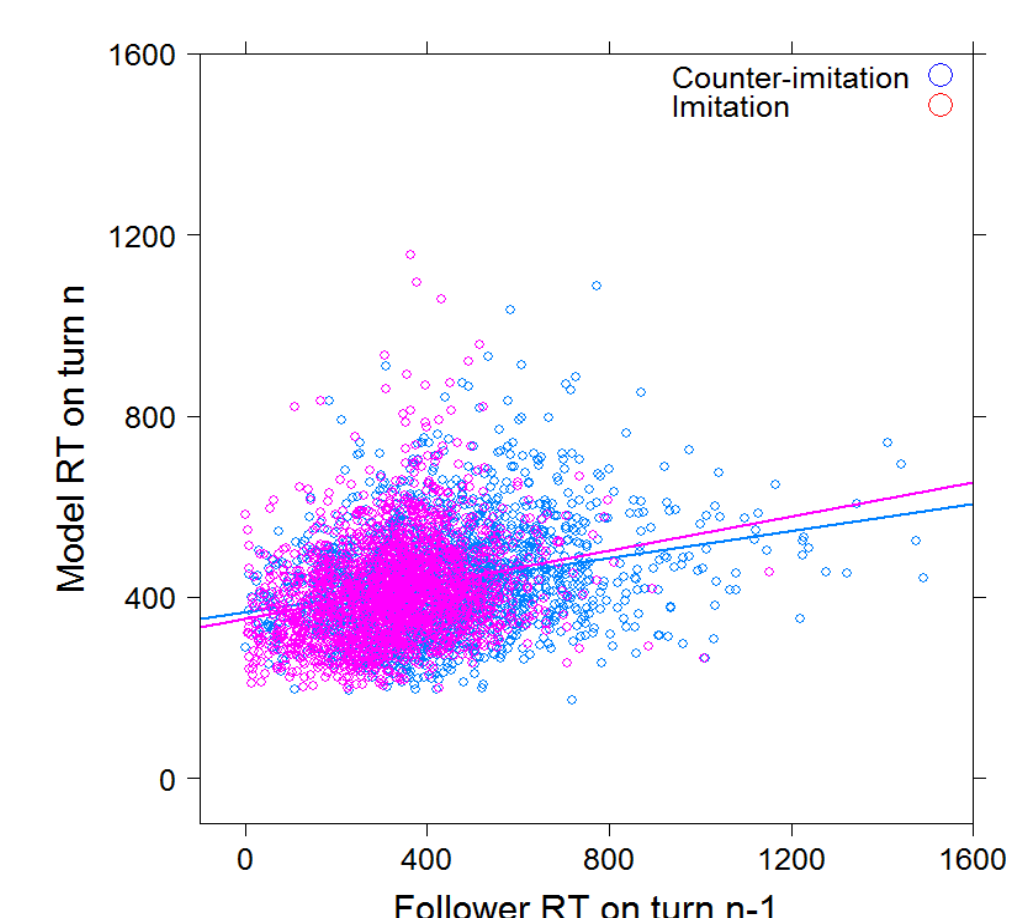


Figure 2 Relationship between Model's RT on the current trial and the Follower's RT on the preceding trial in Exp1

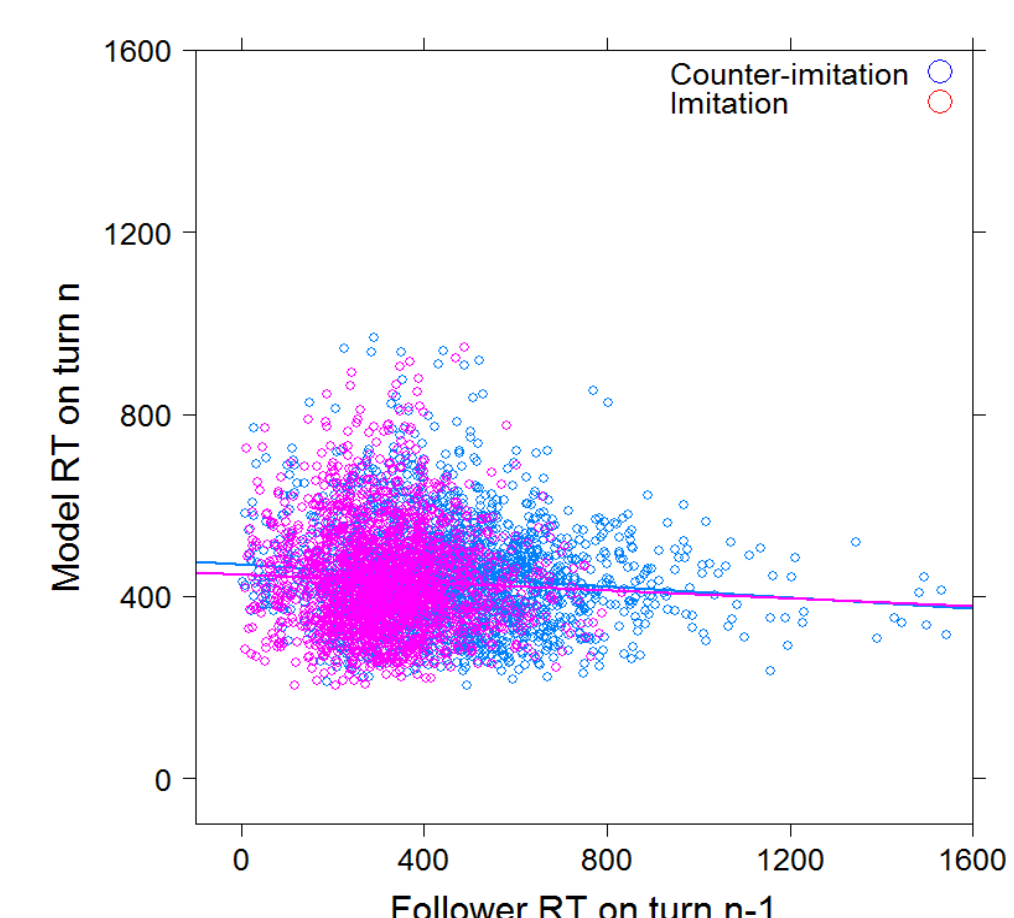


Figure 3 Relationship between Model's RT on the current trial and the Follower's RT on the preceding trial in Exp2

In Exp1, we found that Follower's RT on the preceding trial predicted Model's RT on the current trial ($\beta=12.14$, $t=7.35$).

This effect was not present in Exp2. When feedback was not available, the Model was unaffected by the Follower's behaviour ($\beta=1.04$, $t=0.68$).

Discussion

We showed that the facilitation of model motor movements reported by Pfister et al. (2013) is not due to anticipation of the follower's imitative response. Removing some sources of feedback (i.e. auditory and visual) considerably attenuated the facilitative effect in the model. This suggests that models use rich, multimodal feedback to adapt to their partner's performance. This adaptation is gradual, dynamic and automatic, and occurs even if the joint task is asymmetrical (cf. Konvalinka et al., 2010). Our work (in progress) aims to provide further evidence for adaptation in joint action by manipulating feedback about partner's performance.

References

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